Night of the Living Light Readout Update

Starring:

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LArIAT Meeting

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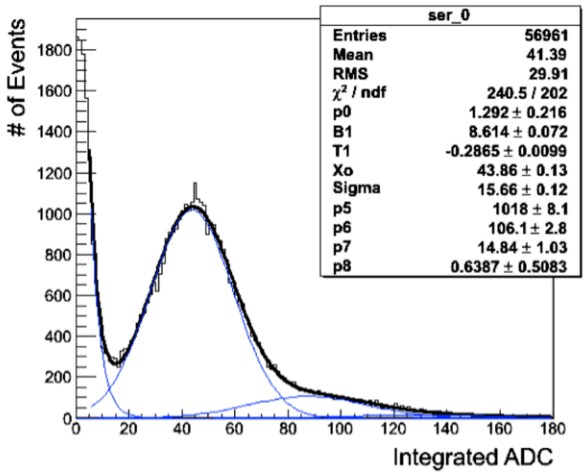
Highlights since last update…

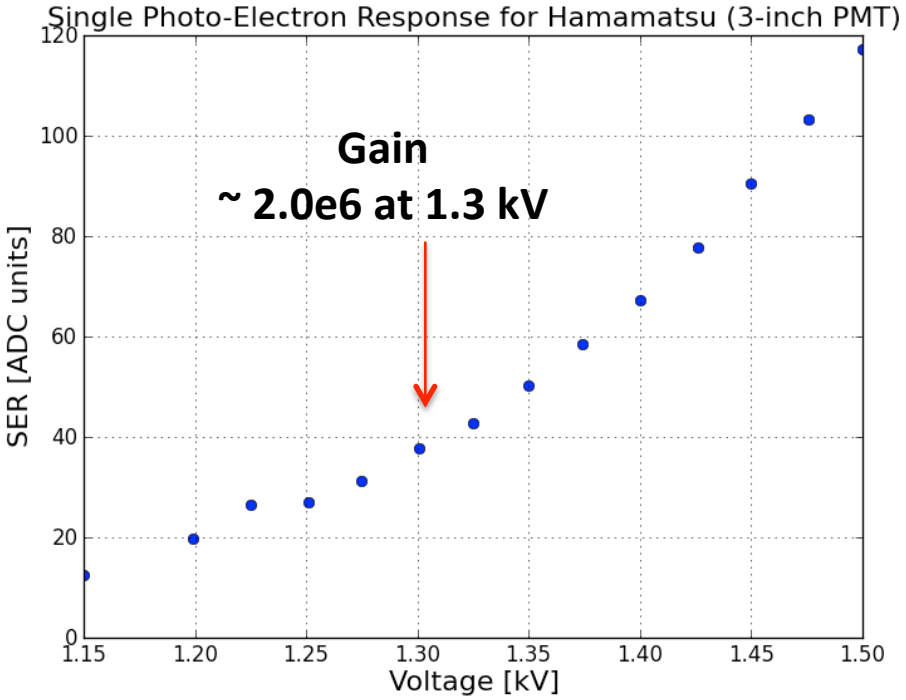
- Plotted gain from 1p.e. response with PMTs using LED pulser + WArP code
- Tried to suppress ringing/noise due to inductance from driving the pulser
  - See “Light readout update (July 18 2013)” on DocDB
- Mounted a SiPM to circuit and began testing the output

SER from PMTs

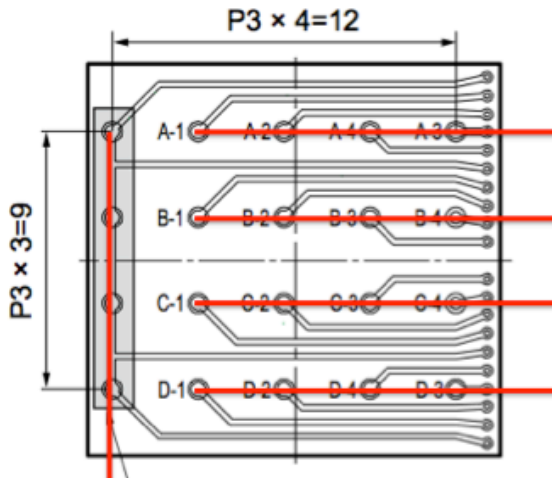
DAQ/processing code gives reliable single photo-electron response

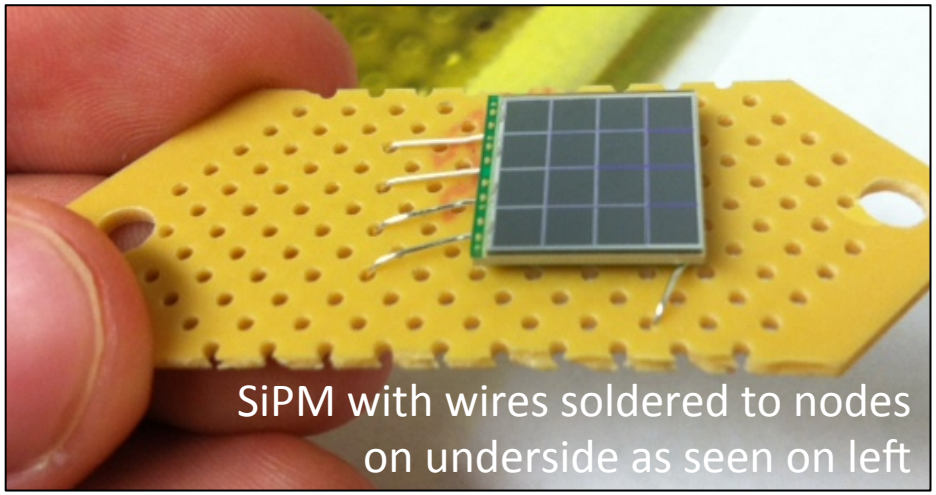
- Increases with HV as expected

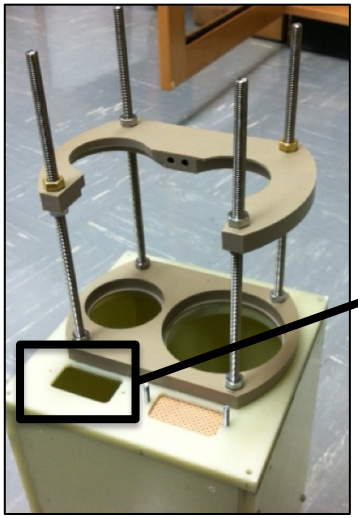


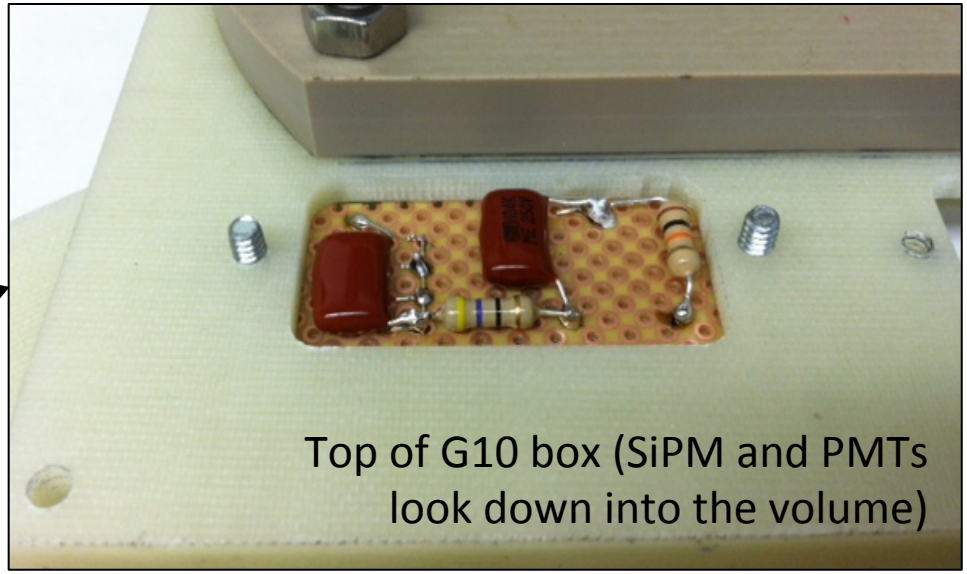


Mounting the SiPM

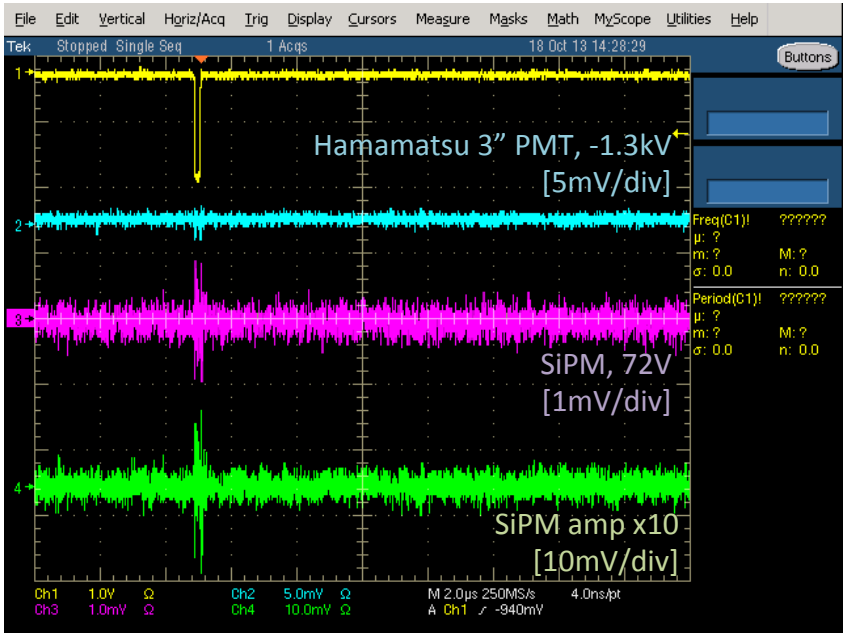


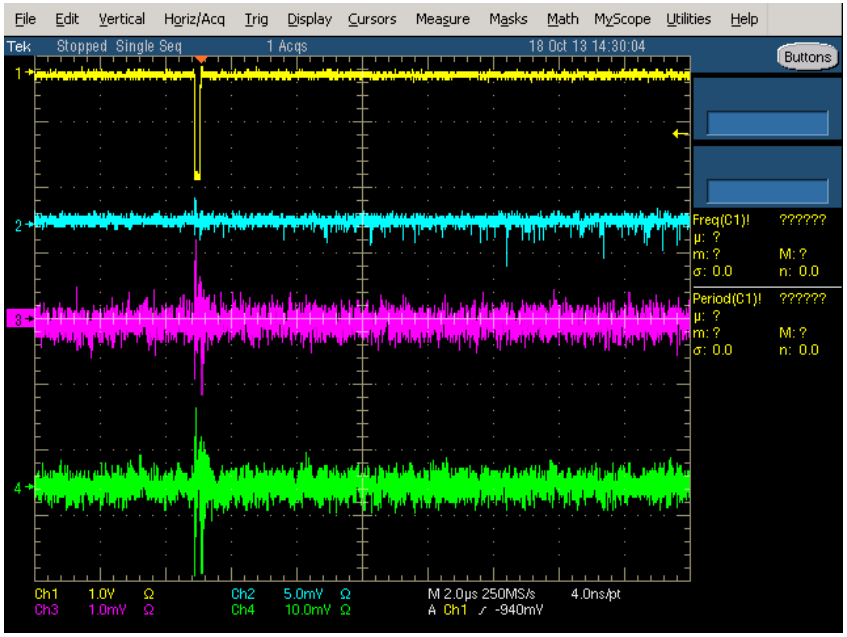

SiPM with wires soldered to nodes on underside as seen on left




Top of G10 box (SiPM and PMTs look down into the volume)

Testing the SiPM



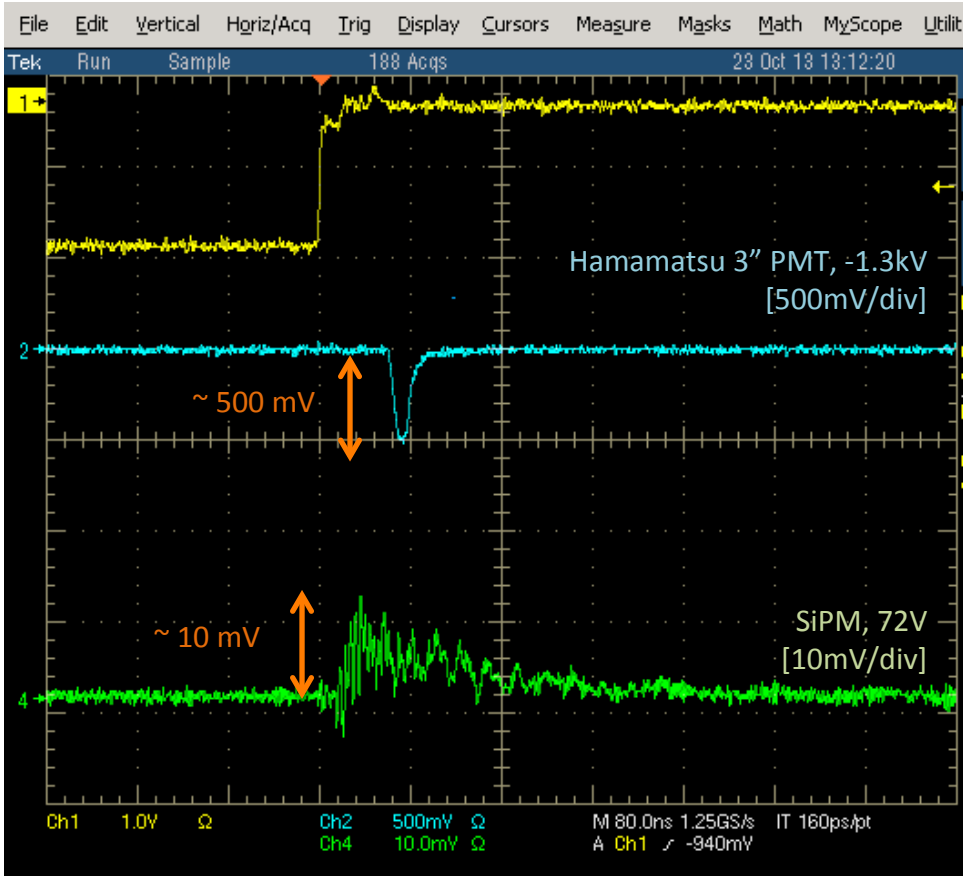


No light → Gradually turn up LED intensity

Cannot see photoelectron peaks in the SiPM like we can in the PMTs…

- Tried amplifying using NIM module for positive PMT amplification (Phillips 774) → amps noise as well as signal

Testing the SiPM



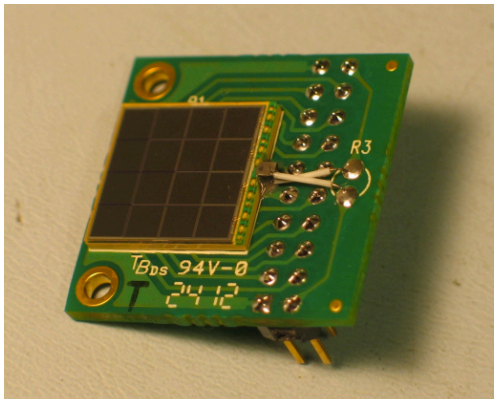
Bright and quick LED flash…

- Seen by PMT as sharp 500mV pulse
- Seen by SiPM as unstable ~10mV pulse with bizarre ringing and long tail

Need better response in order to calibrate the SiPM and be sensitive to SER…

Next steps

- Try different SiPM circuit
  - forward vs. reverse voltage bias?
  - Can we amplify signal without amplifying the noise with it?
  - Mount SiPM to an array board with built-in amplifier circuit?
    - Contacted Hamamatsu about this: they only offer modules with SiPM attached



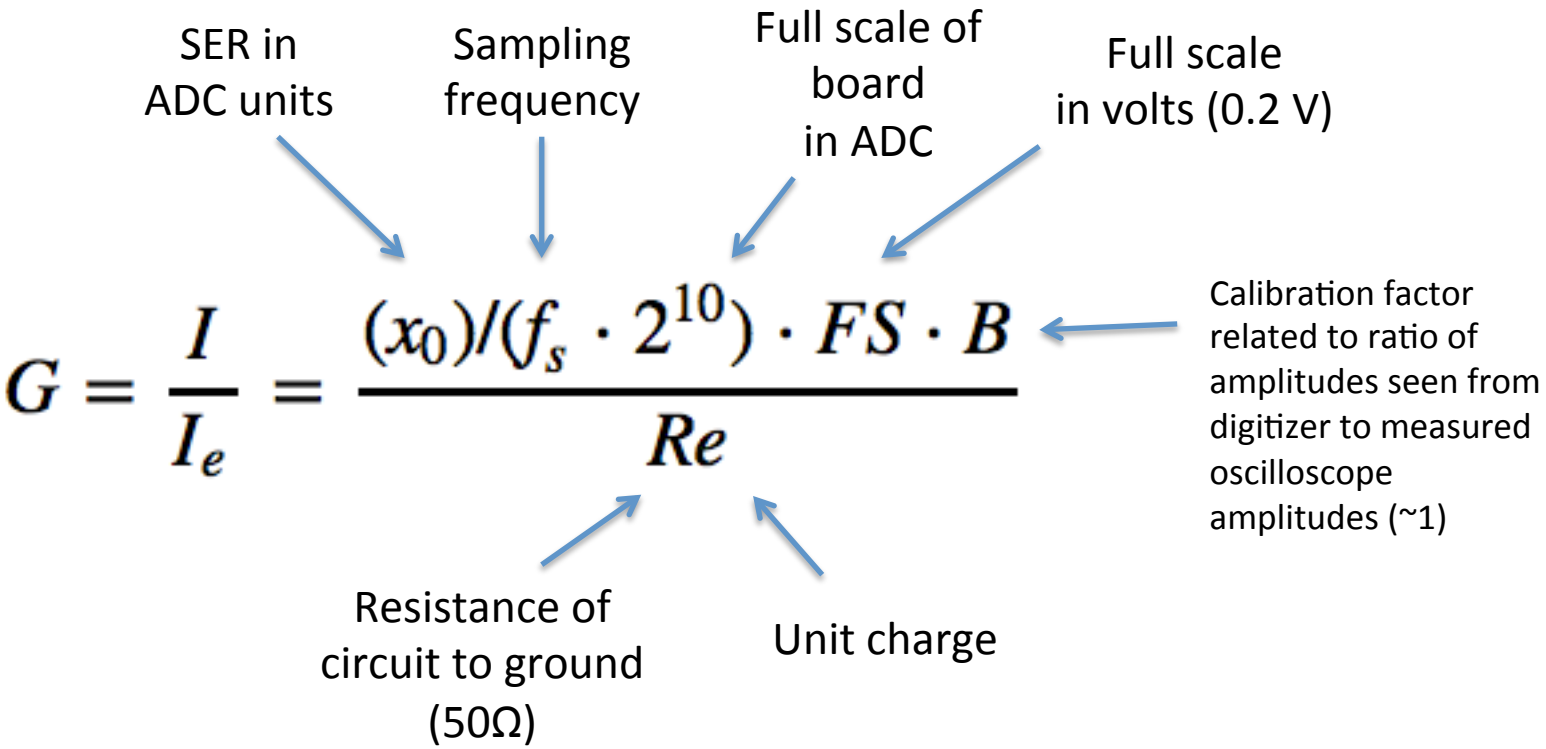
Array board design by P. Bloser
(U. of New Hampshire)

- Readout of SiPM + PMTs in liquid nitrogen
  - May reduce noise enough to see SER from SiPM
  - Considering feeding LED flashes into setup via fiber-optic cable

BONUS FEATURES...

Calculating gain

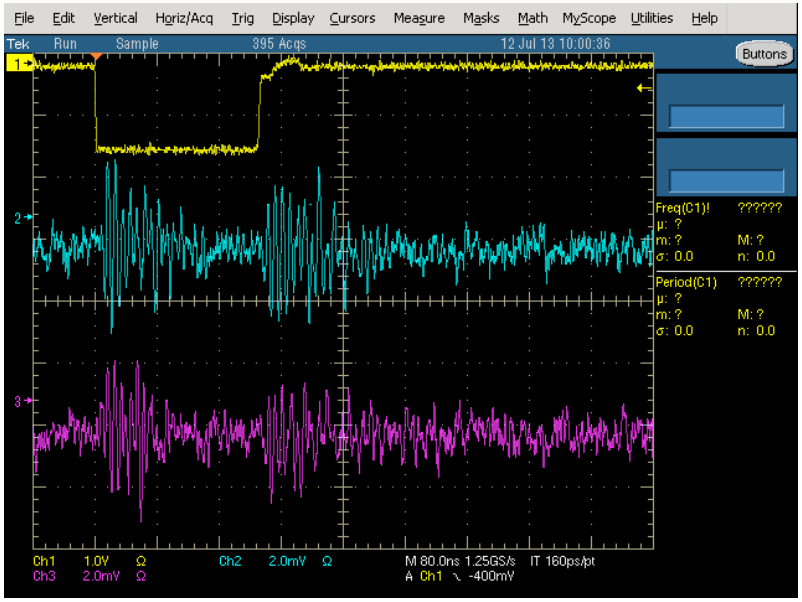
- Converting SER to gain:

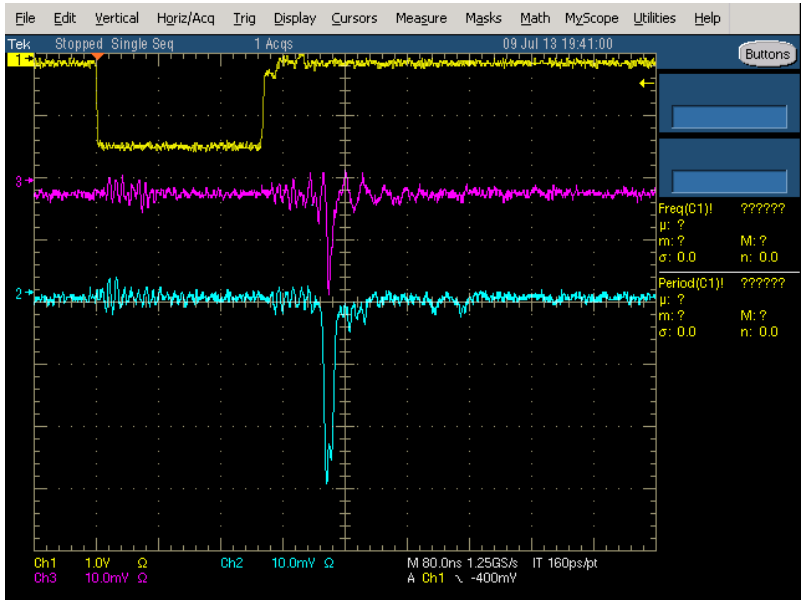


The noise problem

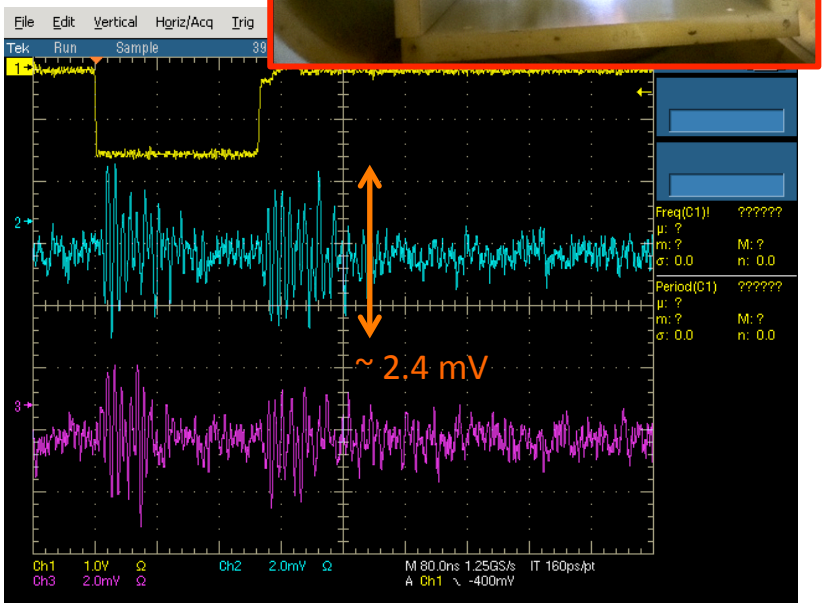
LEMO cable that brings -1.5V square pulse to LED flasher passes close to PMT and SiPM bases

- Induces ringing in output
- Makes it harder to use “narrow flash” mode of LED w/inductor to do SER calibrations – though we get good results using “afterglow” method (w/ no inductor) as seen in previous slide (see **“Light readout update (July 18 2013)”** on DocDB for more info)



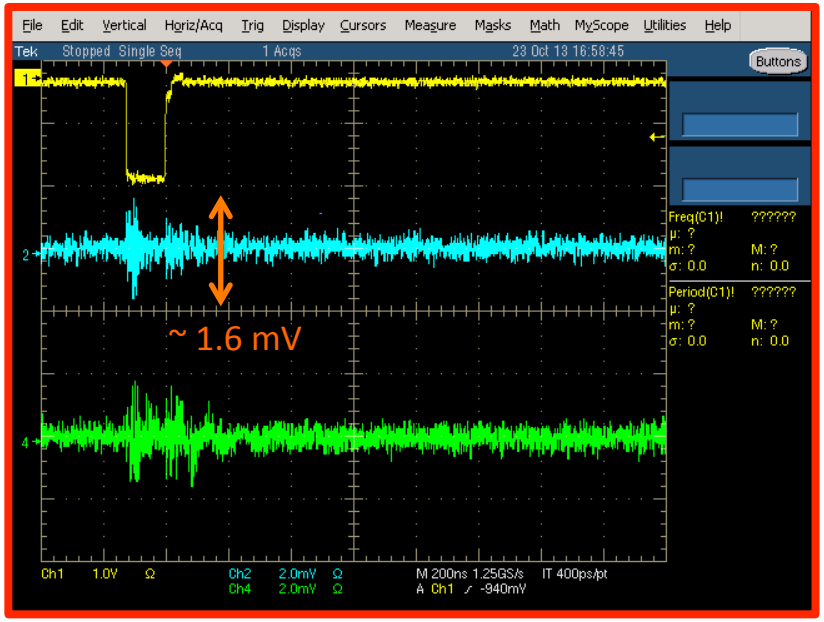


The noise problem



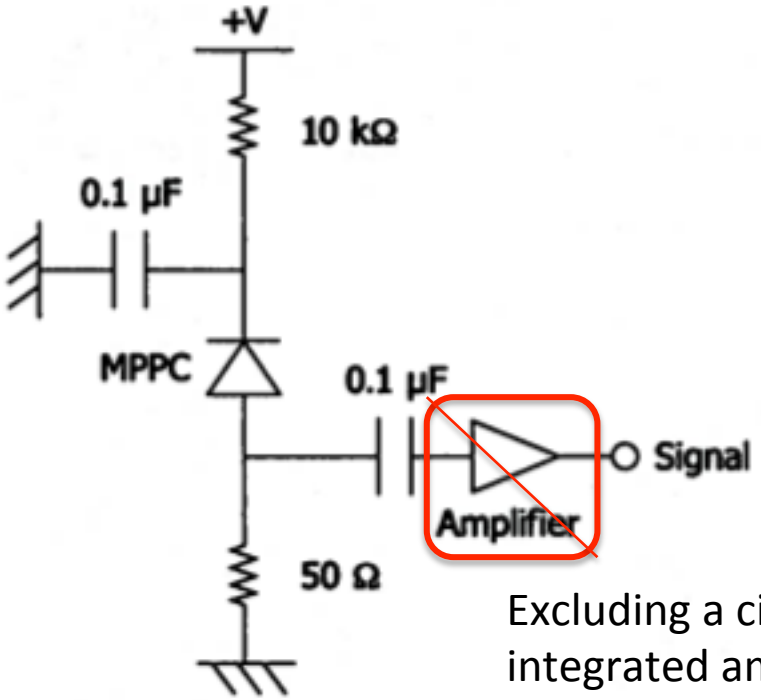
Able to reduce ringing slightly using some readily available cable shielding*

(Will try using steel mesh shielding and/or modifying box for different cable entry)



* Shielding may or may not be aluminum foil

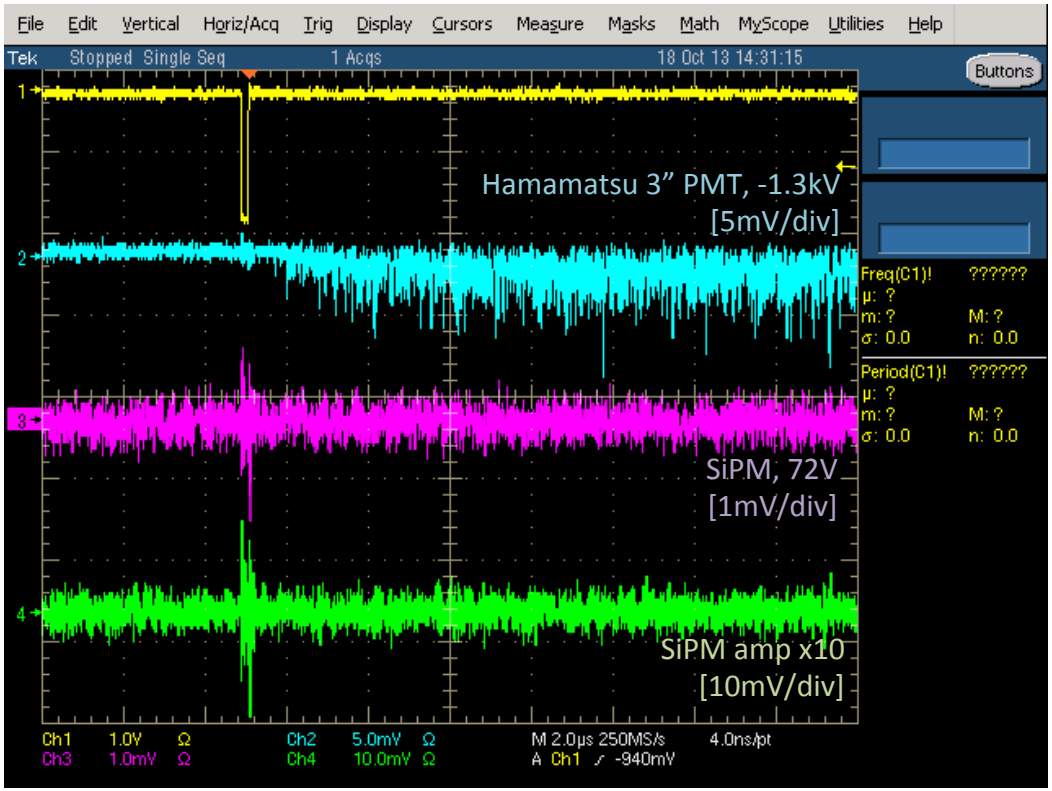
SiPM circuit



Excluding a circuit-integrated amplifier (for now)

Suggested amp:
Hamamatsu C4890 PIN photodiode amplifier

Testing the SiPM



Even with lots of light, where 2-3 phe peaks should show up, we see nothing

From tests being done at PAB, we learned:

- expected SiPM signal on order ~0.1 mV, so it will be impossible to see it above the noise